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# IMPACT OF SOWING TIME AND PLANTING METHOD ON THE QUALITY TRAITS OF WHEAT

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Selecting the suitable sowing method on right sowing dates can maximize the outcomes of the interaction between these two factors, thus increasing grain yield and quality parameters of wheat (*Triticum aestivum* L.). The present study aimed at determining the most appropriate sowing time and methods that maximizes the total crude protein and soluble starch contents of the wheat grains. Wheat cultivar (Sehar-2006) was evaluated under three sowing methods (Bed planting, drill/line sowing and broadcasting) planted at three sowing times (November-15, November-30 and December-30) during 2008 and 2009. Randomized complete block design with split plot arrangements was applied for this study. For both quality parameters (Protein and starch), interaction of sowing methods and time were found non-significant while for the both individual effects significant results were obtained for total soluble starch. For total crude protein, effect of sowing time was non-significant but significant for sowing methods.
**Keywords:** Sowing time; sowing methods; total crude protein; total soluble starches

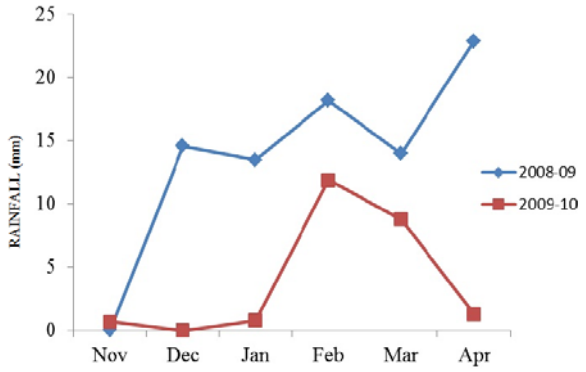
## INTRODUCTION

Wheat (*Triticum aestivum* L.) is an important cereal grain and staple food for millions of people worldwide and third most widely grown crop with unique protein characteristics (Cooke and Law, 1998). Pakistan, ranks among the top wheat producing countries with wheat production 24.23 million tons per annum with an average yield of 2.79 Mg ha$^{-1}$ (GOP, 2012-13). Wheat grains quality is a complex trait resulting from the interactions between several protein components (Daniel and Triboi, 2000). In general, wheat grains contain 8–20% protein (Singh and Skerritt, 2001), 60–70 % starch (Shewry, 2009) and it is important determining bread-making quality (Johansson *et al*., 2001). Increase in grain yield and quality are crucial parameters for wheat crop competitiveness. It has been recognized that grain quality is a function of grain composition predominantly in proteins which in turn depends upon several factors. In several developing countries, it is contributing to 60 % of the daily calorie intake and upto 28 % of the world edible dry matter. Increasing consumption of wheat and substitution with other cereals necessitates enhancing the nutritional quality of wheat in the developing countries (Peleg *et al*., 2008). Several factors affect quality traits (starch and protein) of wheat as sowing date (Silva *et al*., 2014), cultivar (Rao *et al*., 1993), drought (Singh *et al*., 2012), growing environment (Nhan and Copeland, 2014), temperature (Jamieson *et al*., 2001; Triboi *et al*., 2003), nutrients (Triboï *et al*., 2000), heat stress (Corbellini *et al*., 1997) and insect pests (Karababa and Ozan, 1998; Kara *et al*., 2005). Interactions among these factors have also been studied for the protein and starch content of the wheat. Interaction between sowing dates and planting techniques of wheat have yet not been explored. So, keeping in view previous findings present study was aimed at determining the impact of individual effects and interaction between the sowing time and different planting techniques of wheat for the total crude protein and soluble starch.

## MATERIALS AND METHODS

The field study was conducted during years 2008-09 and 2009-10 at the research area Department of Agronomy, University of Agriculture, Faisalabad (31.25°N, 73.09°E with 184.8 m altitude). The soil of the experimental plot belongs to the Lyallpur soil series (Aridisol-fine-silty, mixed, hyperthermic Ustalfic, Haplargid in USDA classification and Haplic Yermosols in the FAO classification scheme). Before sowing of the crop, soil samples were collected to a depth of 0-15 cm and 15-30 cm with soil auger and analyzed for various physico-chemical properties like organic matter content (0.66-0.53 %), EC (0.23-0.37 dS m$^{-1}$), Soil pH (8.4-8.3) and Exchangeable sodium (0.9-1.0 mmol 100 g$^{-1}$). Wheat cultivar Sehar-2006 was sown on raised bed, by drilling and by broadcast method on November-15, November-30 and December-30. Raised beds of 2 feet width were prepared with the help of spade with furrows of 1 foot width in between. There were 3 beds in one plot and 4 rows of wheat on each bed. In drill sowing, single row hand drill was used to sow the seed in

22.5 cm spaced lines and there were 12 lines in one plot. While in case of broadcasting, same amount of seed was simply broadcasted in each plot.




**Graph 1: Seasonal rainfall during the crop period during 2008-09 and 2009-2010**

***Crop husbandry***

A basal dose of nitrogen, phosphorus and potash @ 146 kg N, 85 kg $P_2O_5$ and 35 kg KCl $ha^{-1}$ was applied in the respective plots in the form of urea,diammonium phosphate and sulphate of potash, respectively. The complete dose of P, K and one third of N was applied by broadcast method at the time of sowing while remaining N was applied in two equal splits i.e., $1/3^{rd}$ with first irrigation and $1/3^{rd}$ with $2^{nd}$ irrigation. The first irrigation was applied 20 days after crop emergence and subsequent irrigations were given at different critical crop stages especially at tillering, booting, anthesis and grain development stage. Total five irrigations were applied during the whole crop season.

***Observations***

Crop was harvested at physiological maturity and seeds samples from each plot were grinded and subject to analyze for protein and starch contents. Protein content was determined by Kjeldahl's method (Harold *el al.,* 1981). Nitrogen content was determined and converted to protein by multiplying by 6.25. While for starch content determination, representative grain samples were subject to starch acid hydrolysis method (Anonymous, 1979).

***Statistical analysis***

Experiment was laid out in randomized complete block design (RCBD) having split plot arrangements with three replications. Sowing dates were kept in the main plots while sowing methods were placed in the sub plots. Analysis of the data was carried out by using Fisher's analysis of variance technique and least significance difference test (LSD test) at 5 % was applied to compare the difference among treatment means (Steel *et al*., 1997).

**RESULTS AND DISCUSSION**

Year effect was non-significant so pooled data for total crude protein and total soluble starch for the both years was presented here in Table 1 and 2. Experimental results showed that interaction between the sowing dates and planting methods was non-significant for total crude protein and soluble starch content during years 2008-09 and 2009-10 (Table 1 and 2). While in case of individual effects the factor that was given more importance and placed in sub-plots, sowing techniques significantly influence the total crude protein and soluble starch contents of wheat grains (Table 1 and 2). While sowing dates significantly influences the total soluble starch contents (Table 2) but in case of total crude proteins, the influence was non-significant (Table 1). Regarding sowing methods, maximum crude protein contents were recorded where wheat was planted on raised beds and planted through drill machine in lines (Table 1). The crude protein contents recorded in these two methods were statistically equal. In case of broadcasted wheat, least protein contents were detected (Table 1). As far as, total soluble starch contents were concerned, maximum soluble starch percentage was estimated between the sowing methods of bed planting and drilling in lines where similar content percentages were recorded (Table 2). While similar to protein contents, under broadcasted wheat, less starch content values were harvested. Statistically variable quantities of starch contents were observed in wheat planted at varying dates. Total soluble starch contents tend to decrease with the delay in sowing of wheat and maximum values were recorded at November-15 planted wheat which was followed by drilling at November-30 and December-30 (Table 2).

Interaction between sowing date and sowing method for grain yield was also non-significant. While among the individual effects, maximum grain yield was recorded under bed planted and drilled wheat and in case of sowing date, November-15 planted wheat produced maximum yield. Yield data has been earlier published (Farooq and Cheema, 2013). Non-significant year effect for quality traits of wheat was earlier observed by Abdullah *et al*. (2007). Delay in planting of wheat reduced wheat yield but enhanced the protein content in different cultivars of wheat (Patil *et al*., 2000; Coventry *et al*., 2011) but contrary to these findings, in our experiment delay in sowing not only reduced the grain yield but also protein and starch content of grains. These contrary results might be due to the prevalence of more rainfall during the end of the season that leach down the N content in soil (Graph 1) because excessive rainfall during the growing season has a big impact on available N. With excess water and good growing conditions, wheat plants will send their roots laterally across the soil profile looking for moisture, and not downward. If rains persist, N will be leached to a level below the shallow root development. Further, if subsoils are too wet, deeper rooting ability may be impaired, thus decreasing N uptake efficiency. While in case of sowing methods, bed planting and drilling suffers less weed competition (Farooq and Cheema, 2014b; Hassan *et al*., 2005) so wheat plants have ideal environment to utilize the available nutrient resources and transform them into the end products like protein and starches. Growing conditions can significantly influence the

**Table 1: Effect of sowing dates and sowing methods on the total crude protein (%) of Wheat**

| Sowing Dates | 2008-09 and 2009-10** |
|---|---|
| ***D₁** = November 15* | 12.23 |
| ***D₂** = December 30* | 12.37 |
| ***D₃** = December 15* | 12.24 |
| LSD (p) 0.05 | NS* |
| **Sowing Methods** | |
| ***S₁**= Bed Sowing* | 12.74 a† |
| ***S₂**= Drill Sowing* | 12.65 a |
| ***S₃**= Broadcasting* | 11.46 b |
| LSD (p) 0.05 | 0.44 |
| **Interactions** | |
| $D_1S_1$ | 12.77 |
| $D_1S_2$ | 12.87 |
| $D_1S_3$ | 11.07 |
| $D_2S_1$ | 12.77 |
| $D_2S_2$ | 12.48 |
| $D_2S_3$ | 11.87 |
| $D_3S_1$ | 12.69 |
| $D_3S_2$ | 12.60 |
| $D_3S_3$ | 11.44 |
| LSD (p) 0.05 | NS* |

† Means not sharing a letter in common differ significantly at 0.05 p; ** Year effect was non-significant; NS* = Non-Significant

**Table 2: Effect of sowing dates and sowing methods on the total soluble starch (%) of wheat**

| Sowing Dates | 2008-09 &2009-10** |
|---|---|
| ***D₁** = November 15* | 62.26 a† |
| ***D₂** = December 30* | 60.89 b |
| ***D₃** = December 15* | 59.50 c |
| LSD (p) 0.05 | 0.71 |
| **Sowing Methods** | |
| ***S₁**= Bed Sowing* | 61.36 a |
| ***S₂**= Drill Sowing* | 61.35 a |
| ***S₃**= Broadcasting* | 59.94 b |
| LSD (p) 0.05 | 0.71 |
| **Interactions** | |
| $D_1S_1$ | 62.71 |
| $D_1S_2$ | 62.71 |
| $D_1S_3$ | 61.37 |
| $D_2S_1$ | 61.36 |
| $D_2S_2$ | 61.32 |
| $D_2S_3$ | 59.99 |
| $D_3S_1$ | 60.02 |
| $D_3S_2$ | 60.01 |
| $D_3S_3$ | 58.47 |
| LSD (p) 0.05 | NS* |

† Means not sharing a letter in common differ significantly at 0.05 p; ** Year effect was non-significant; NS* = Non-Significant

starch and protein contents (Burešová1 *et al*., 2010), as in case of broadcast method weed competition is more (Byerlee *et al*., 1986) and weed can utilize the nutrients more efficiently than the crops so this might be the main reason of low protein and starch contents in broadcast method of sowing.

## CONCLUSION

From the overall discussion of the results of the experiment, it is found that bed sowing and drilling is better for obtaining higher percentage of protein and starch contents while planting of wheat at November-15 gave better starch content in wheat grains. Moreover, there is no interaction between sowing methods and sowing dates for improving quality traits (protein and starch) of wheat.

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